Coriolis effects in ^{235}U

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In their paper of 1968, Stephens et al. [1] recognised the unique role of ^{235}U as a laboratory for the study of Coriolis effects in nuclei. Firstly, Coriolis matrix elements increase with increasing j of the orbitals, and the j15/2 multiplet is the highest j-value attainable in normal nuclei. Secondly, because the Fermi surface lies near the j7/2 member ([743]7/2 is in fact the groundstate), rotational bands on all eight members of the multiplet, K=1/2 through K=15/2 should lie reasonably low in the spectrum. Thirdly, although several nuclei near ^{235}U would satisfy these conditions, ^{235}U, and ^{237}Pu are the only cases where a member of the j15/2 multiplet is the ground state; this property is essential if we are to measure E2 matrix elements between members of the multiplet by Coulomb excitation, and hence determine the mixing amplitudes directly. The nuclide ^{237}Pu is too short-lived to make a convenient target.

With the parameter-set derived in [1], an exact diagonalisation of the Coriolis interactions within the j15/2 multiplet reproduces the earlier result shown in Fig 1 as the filled points. This fit involves the attenuation of the expected K3/2-5/2 and K5/2-7/2 Coriolis matrix elements by about a factor of two: a result extensively discussed by Stephens et al. [1] and by Bohr and Mottelson [2]. With the new data shown as open points, we see that with increasing spin, there is a general departure from the predictions of the earlier best parameters.

We see two problems. Firstly, why are the Coriolis matrix elements attenuated even at the lowest spins? This we hope to answer by analysis of the E3 correlations, and to do this in a quantitative manner, since we have experimentally determined the important B(E3)-values. The effect of E3 correlations is to mix the negative-parity j15/2 intruder states with lower-spin positive-parity states, thereby decreasing the high-j content of the intruder wavefunctions and hence reducing the Coriolis effects.

Secondly, why are the Coriolis effects so strongly damped with increasing rotational frequency? Many factors could come into play here. We note that the K=3/2 and K=11/2 gamma-vibrational bands can not be left out of the picture since they are certainly mixed with the ground-state band and probably with other members of the multiplet.The new data also show that there is an "avoided" crossing between the K=11/2 gamma band and the [734]9/2 band at spin 17/2. Clearly this effects how one interprets the results of the top panel in Fig1.

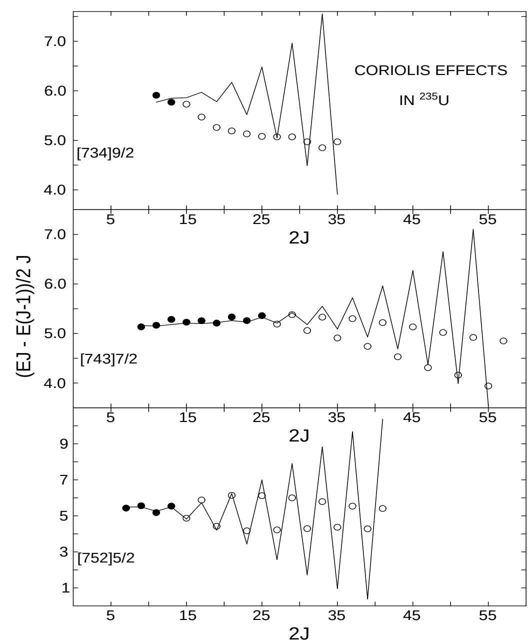

FIG. 1: The rotational constant calculated for members of the j15/2 multiplet with the parameters of ref [1]

REFERENCES

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[2] A. Bohr and B.R.Mottelson, Nuclear Structure pp. 273,283 (1975).